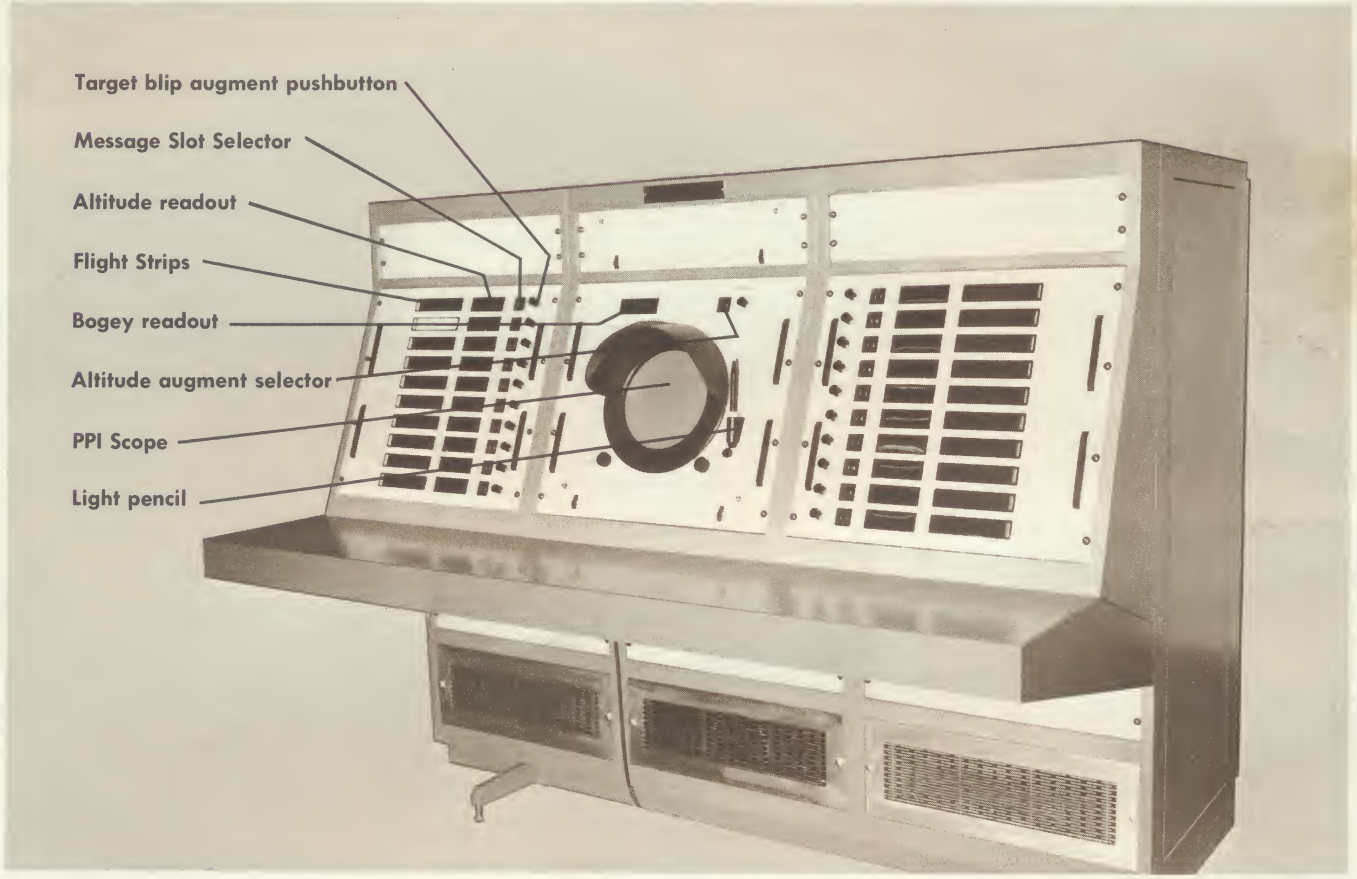
MCDONNELL
FLIGHT-FOLLOWING GROUND STATION

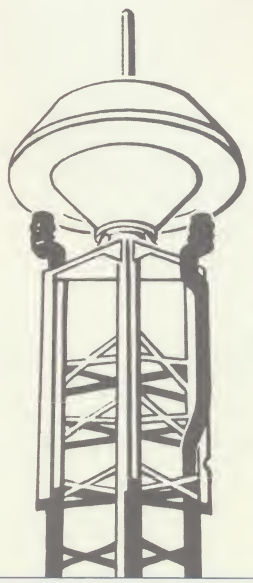
for use in conjunction with the McDonnell Airborne Collision Avoidance System.*



The McDonnell Collision Avoidance System for aircraft utilizes frequency and time synchronization of precision oscillators to create a highly accurate time base for range and range-rate measurements. Airborne units function in cooperation with each other to provide warning and positive, unambiguous cockpit instructions for collision avoidance.

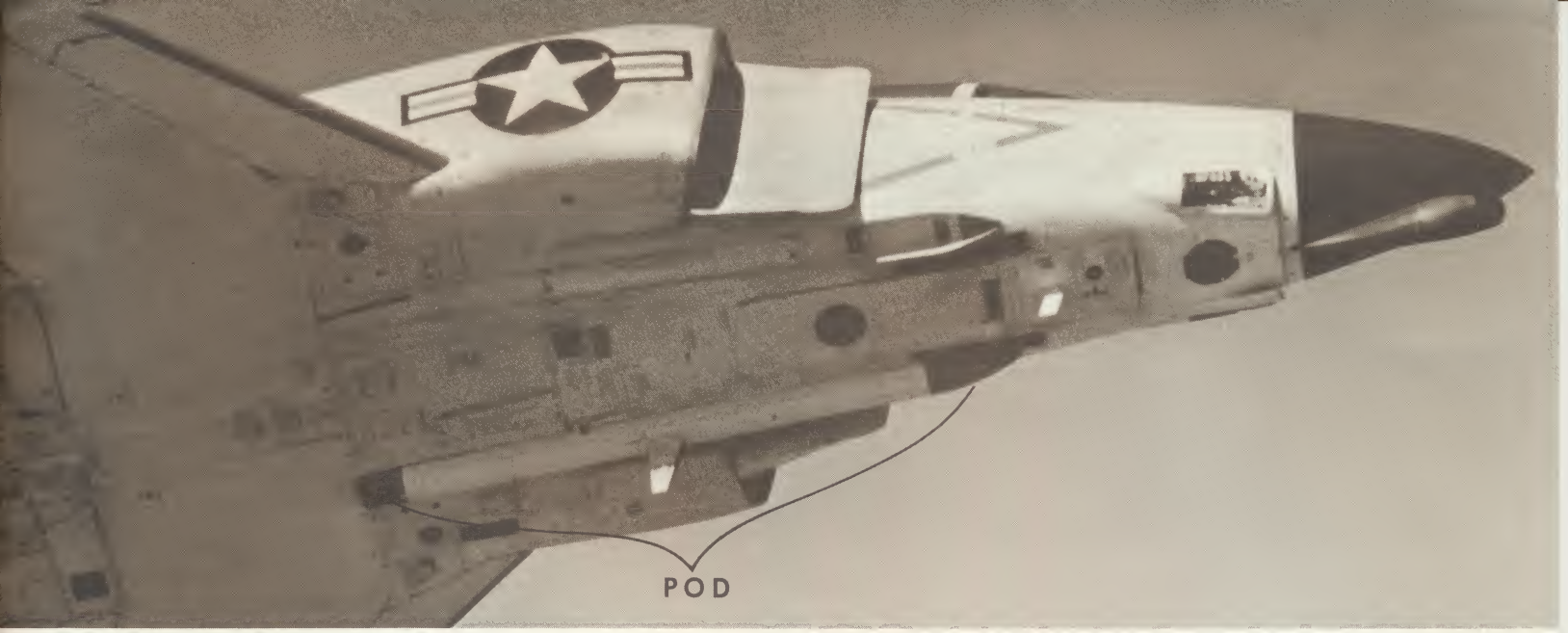
The McDonnell Flight-Following Ground Station may be operated in conjunction with airborne collision avoidance units to provide various identification and flight-following services and to transmit the synchronization signal from a master oscillator to airborne units. The Ground Station may also be used to generate and transmit a test sequence for preflight ramp checkout of collision avoidance systems.

The Ground Station provides flight-following functions useful for air traffic control without voice communication or modification of airborne collision avoidance systems. *Range and azimuth* of all airborne systems are presented as blips on a PPI Scope. *Flight levels* of airborne systems under control appear on numeric counters in 200-foot increments. Location on the scope of any individual airborne system is achieved through push-button augmentation. *Identification* of any PPI scope blip is accomplished through use of a light pencil detector. When the pencil is held over a blip on the scope, its output causes the appropriate backlighted augment switch to be illuminated. *Altitude sorting* is accomplished by ground station augmentation of airborne system blips at altitudes selectable by the controller. The prototype ground station, operating at McDonnell now, permits flight-following 20 aircraft plus *bogey detection* of non-selected airborne systems arriving in a control area. The unit is readily expandable to permit handling of any number of aircraft up to 999.



Ground Station
Antenna

*U.S. PATENT NO. 3,250,896; BELGIUM. 653,583; FRANCE, 1.417,240; LUXEMBOURG, 47,020 AND OTHER DOMESTIC AND FOREIGN PATENTS PENDING.



Airborne units function in cooperation with each other to provide warning and positive, unambiguous cockpit instructions for collision avoidance. Airborne units are synchronized by signal from the ground station every two seconds.

McDonnell jet fighter development and production flights are flown in Special Operating Areas established by FAA. Aircraft separation in these Areas is provided by the McDonnell EROS system.

DESIGN

The McDonnell Flight-Following Ground Station comprises a console, a master oscillator, and a transmitting/receiving/direction-finding antenna with a parametric amplifier. Interconnecting cables are specifically designed for installation parameters and are therefore not considered part of the standard ground station.

TRANSMITTER:

The transmitter consists of a frequency multiplier and a pulse-modulated, five-stage power amplifier. The multiplier accepts a basic five mhz reference signal input and multiplies it to obtain the transmitted frequency of 1545 mhz. Transmitter output is 1,000 watts.

ANTENNA:

The ground station antenna consists of a separate transmitting antenna and receiving antenna mounted on the same tower. The transmitting antenna is a quarter wave stub. Bearing information is acquired by feeding a coaxial waveguide with a discone type receiving antenna, and processing two resultant orthogonal coaxial waveguide modes.

PARAMETRIC AMPLIFIER:

A three channel parametric amplifier provides amplification at a low noise figure, permitting effective system performance to a range of approximately 140 nautical miles (line-of-sight).

RECEIVER:

The receiver accepts parametric amplifier outputs at 1545 mhz and generates from these the video signal and phase related signals from which range, altitude and azimuth information is derived.

CENTRAL TIMER:

This unit provides accurate time base signals for use by other system units. The reference frequency is derived from a 5 mhz oscillator with a stability of one part in 10^{10} per 24 hours.

RESYNCHRONIZATION:

"Resync" electronics perform message slot counting and control signal generation, video verification, synchronization signal generation and transmitter modulation control functions.

RANGE-AZIMUTH COMPUTER:

The Range Azimuth Circuitry accepts the outputs of the Receiver and generates deflection voltages for the PPI display.

The PPI display is basically a commercially available storage oscilloscope with a modified delay to permit track storage control, and with added peripheral electronics blip augmentation and correlation.

GROUND STATION ADAPTER:

The Ground Station Adapter generates test signals which permit preflight checkout of aircraft collision avoidance systems. The Adapter simulates airborne subsystem transmissions. Six test ranges, five test altitudes, and two test closing rates are transmitted in a published sequence for system checkout by the pilot.